FOREST PRODUCTS
Project Fact Sheet

CONTACTLESS REAL-TIME MONITORING OF PAPER MECHANICAL BEHAVIOR DURING PAPERMAKING

BENEFITS

- Ability to monitor papermaking processes on the dry end of the paper machine
- Simplified development of full-sheet systems
- Less refining and less remanufacturing
- Optimal use of pulp feedstock
- Reduced energy use
- Minimal waste
- Consistently high-quality final product

APPLICATIONS

Following field trials and technical and economical assessments, the technology is expected to be ready for the industrial partner to proceed to commercialization. Systems will be implemented on low and high basis weight grades.

A Noncontact Sensor Will Offer Advantages for Monitoring the Mechanical Behavior of Paper During Production

During paper manufacturing, various paper properties such as grammage and thickness are monitored. The mechanical properties of the paper are not measured, however, even though on-machine, paper-stiffness sensors have undergone refinements for more than 25 years. The rationale for monitoring on-machine stiffness is three-fold: to allow real-time control of a paper machine by providing critical but missing information, to optimize use of raw materials, and to optimize end-use properties of paper.

Current methods to probe paper stiffness consider the use of transducers in direct contact with the web. This approach is not desirable for several reasons. Contact transducers can potentially damage the web, leading to costly production losses. Also, these transducers are not designed to operate with fine papers such as copy paper, thereby limiting the range of applications to paperboards.

This project will demonstrate a noncontact method using laser ultrasonics to monitor different paper-stiffness properties on a moving web, in the laboratory, and later in a mill environment. In order to interpret the results, the project addresses the development of a semi-empirical model to relate stiffness properties to papermaking processes.

Partial view of the system for non-contact laser ultrasonic generation and detection on a moving paper web. The green spot is the laser spot of the detection beam. Paper grade shown is white copy paper (80 g/m2). Thanks to a successful cooperation with Lasson Technologies, Inc., the technology under development is capable of measuring ultrasonic waves on moving webs up to 30 m/s (5900 ft/min), which is at or above production speeds. In parallel, we have developed our own ultrasonic detection system for exploring the relations between the stiffness constants of paper and ultrasonic waveforms as a function of the paper grade and generation conditions.

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ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

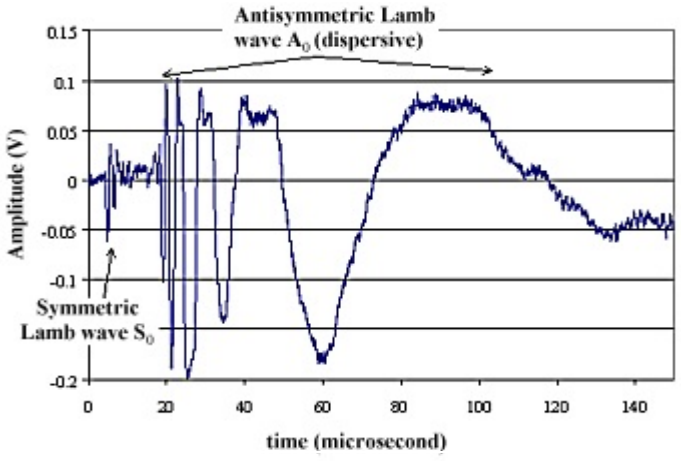
PROJECT DESCRIPTION

Goal: Apply laser ultrasonics toward developing a noncontact sensor technology that the industry can use to continuously monitor the mechanical behavior of paper during paper manufacturing.

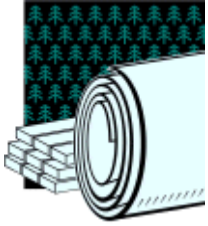
Researchers will use laser ultrasonics to excite and detect Lamb waves propagating in the plane of paper. Once Lamb wave velocity is measured, paper stiffness can be determined, and with that information, papermakers can gather real-time information on short- and long-term trends.

PROGRESS & MILESTONES

- Phase I, completed in October 1998, focused on the laboratory evaluation of five different laser ultrasonic methods suitable for testing of a rough moving surface.
- The data obtained will be used in Phase II of the project to develop a prototype sensor for simultaneous on-machine detection of paper stiffness and fiber orientation distributions.
- The final objectives, in Phase III of the effort, will be to carry out field demonstrations of a mature prototype sensor in fine paper and linerboard mills.
- Technical and economic evaluations of the instrumentation will also be performed in Phase III.



Ultrasonic waves generated and detected on a moving paper web by the laser ultrasonics system. S_o is related to the Young's modulus of paper and A_o to its bending stiffness.



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